INJECTION MOLDING APPARATUS

BACKGROUND OF THE INVENTION

By means of the present apparatus, the synthetic material is melted in the heated extruder and homogenized at the same time. The foaming agent may have already been added to the synthetic material or may be mixed with it in the extruder. The foaming agents liberate the expanding gases by thermal separation, so that the plastic must be heated above the separation temperature, while it is kept under a pressure such that the foaming up of the plastic is completely prevented. Therefore, this temperature can only be surpassed at the extruder exit. It was, therefore, recommended in German Pat. DT-OS No. 1,932,437, that heating above this temperature can only take place in the connection between the extruder and the transfer cylinder. It is also well known, as per German Pat. DT-AS No. 1,233,578 and also per German Pat. DT-OS No. 1,903,540, that the plastic should only be heated above the separation temperature in the transfer cylinder proper or at its exit, in the area of the nozzle. This is true whether the foaming agent is liquid or gas forming; the pressure existing at any given time must surpass the vapor pressure of the foaming agent at the existing temperature.

In all these cases a homogenous plasticized synthetic material will be formed, which will expand and fill up the mold, due to the pressure relief. The particles of the synthetic material which are nearest to the surface of the mold cavity will be cooled so fast that they foam very little and will lay on the mold cavity wall in a very smooth state. On the other hand, in the areas separated from the walls, foaming will occur, so that the resulting casting entirely fills the cavity despite the shrinkage of the synthetic material during the cooling process. A casting will be produced which, by the effect of the massive and stable limit zones, will have an average density which will fall well below that of the synthetic material, because of the presence of the captive bubbles. The problem still appears that, even with polished cavity surfaces, synthetic materials containing foaming agents have a tendency to form castings with a superficial texture. If, however, a given texture is desired, it is possible to form the walls of the cavity with markings or texture, without the need of additional structure.

In order to suppress such texture, it has already been proposed that the pressure existing in the cavity must be increased at least momentarily, or otherwise, the charge being brought into the cavity must be separated into two components as per German Pat. DT-AS No. 1,778,457, such that one is free of foaming agent and the other containing the foaming agent. For carrying out this process, a machine can be used which introduces the charges one after the other; two extruders with corresponding transfer cylinders can be foreseen, which would be connected to a single nozzle by means of valves, and working together with the former, guiding pieces connected in series. These transfer cylinders can also be, as per German Pat. DI-OS No. 2,241,002, made to work partially in parallel, where the middle of the stream is formed by the expelled contents of one of the cylinders, while the extruded material from the other is located at the outside of the stream. In this way, one can be sure that the extruded material containing foaming agent will be completely surrounded by extruded material free from foaming agent. The necessary expense is relatively high, because one not only must take into account the fact that the extruder and the transfer cylinder are duplicated, but also that both cylinders fed separately must impel the outgoing synthetic material in synchronism, so that efficient and fast acting valves as well as accurate controls are required.

Difficulties are also experienced in the lead bodies and also during the gliding of the synthetic material masses against each other, after they are led together. Further problems appear by the change in the masses of synthetic, for example, for a color change. In this case, it will be necessary to completely regulate the action of the two extruders, the two transfer cylinders and the complicated extra-flow arrangement, because otherwise color errors will appear in the extrusion.

The present invention stems from the task of finding a process for charging a mold with plastic synthetic material containing a foaming agent, with little expense and using simple methods; producing a stream of synthetic material which at the exit from the nozzle and entrance to the mold has an outer limiting zone which does not foam; whereas in a central region of the stream flowing into the mold, the synthetic material foams in the known way. The central region is completely surrounded by the "non-foaming" material of the limiting zone.

SUMMARY OF THE INVENTION

In general, the present invention solves the problem by the additional heating of the inner region of the foaming stream made out of or being made out of synthetic material containing the foaming agent, and the cooling of the outer zone. Thus, the outer zone of the stream entering the mold will have a higher viscosity than that of the inner zone. This higher viscosity of the material of the outer zone causes its "foamability" to be lowered, as compared with that of the material of the inner zone of the stream without allowing the "fitting" against the walls of the cavity to be surpassed beyond the desired value. In addition, any foaming agent contained in the cooler outer part of the stream will react more slowly (or, when its separation temperature is not exceeded, very little or not at all), so that the action obtained through the higher viscosity of the outer zone will be strengthened.

In order to carry out the process, a hollow nozzle needle has been used. This needle is located against the outlet opening of the nozzle and its position is adjustable. It can produce a closing of the nozzle, and is supplied with a ring-shaped protuberance or frontal surface which can rest upon the nozzle opening. It is also equipped with a rod-shaped heating element. This nozzle may have the heating element inside its inner space. A strong heating of the middle zone of the outgoing stream can be accomplished if the heating element is located in a closed tube at the front side which can be attached to the nozzle needle and freely grips through the outlet opening and extends itself in front of the nozzle. In another way, the heating element can also be located in a tube closed in the front, which can axially slide inside the nozzle needle and be pulling the latter backwards, can, at least within some range, be advanced, thanks to the free play of the passage.

The process can also be conducted by the use of a pouring sleeve, which during the changing of the mold remains in contact with the mouthpiece of the nozzle and shares in the resulting cooling of the mold. The use of a cooled pouring sleeve can also be anticipated to-